Training Solutions, Delivered!

SAFE ELECTRICAL WORK PRACTICES & 2015 NFPA 70E®

(Concise)

Leader's Guide, Fact Sheet & Quiz

Item Number: 4659

This easy-to-use Leader's Guide is provided to assist in conducting a successful presentation.

PREPARING FOR THE MEETING

Here are a few suggestions for using this program:

a) Review the contents of the Fact Sheet that immediately follows this page to familiarize yourself with the program topic and the training points discussed in the program. The Fact Sheet also includes a list of Program Objectives that details the information that participants should learn from watching the program.

b) If required by your organization, make an attendance record to be signed by each participant to document the training to be conducted.

c) Prepare the area and equipment to be used for the training. Make sure the watching environment is comfortable and free from outside distractions. Also, ensure that participants can see and hear the TV screen or computer monitor without obstructions.

d) Make copies of the Review Quiz included at the end of this Leader's Guide to be completed by participants at the conclusion of the presentation. Be aware that the page containing the answers to the quiz comes *before* the quiz itself, which is on the final page.

CONDUCTING THE PRESENTATION

a) Begin the meeting by welcoming the participants. Introduce yourself and give each person an opportunity to become acquainted if there are new people joining the training session.

b) Introduce the program by its title and explain to participants what they are expected to learn as stated in the Program Objectives of the Fact Sheet.

c) Play the program without interruption. Upon completion, lead discussions about your organization's specific policies regarding the subject matter. Make sure to note any unique hazards associated with the program's topic that participants may encounter while performing their job duties at your facility.

d) Hand out copies of the review quiz to all of the participants and make sure each one completes it before concluding the training session.

4659 SAFE ELECTRICAL WORK PRACTICES & 2015 NFPA 70E® (Concise)
FACT SHEET

LENGTH: 15 MINUTES

PROGRAM SYNOPSIS:
Every year, electrical workers are seriously injured or killed by contacting energized parts or being subjected to an electrical arc flash. To prevent these types of incidents, these workers and the organizations for which they work must understand and follow up-to-date electrical safety-related electrical work practices, maintenance requirements and administrative controls. One of the leading authorities on electrical safety is the National Fire Protection Association, the NFPA. Their document number 70E is recognized by many regulatory authorities and organizations as the "best practices" for electrical safety. This program provides an overview of the 2015 edition of NFPA 70E and shows how following its guidelines helps keep electrical workers safe.

Topics include approach boundaries, skills required of qualified electrical workers, selecting arc-rated clothing and protective equipment, arc flash PPE categories, creating an electrically safe working condition and when energized work is permitted.

PROGRAM OBJECTIVES:
After watching the program, the participant should know:
- What the approach boundaries and how their distances are determined;
- How to properly select arc-rated clothing and protective equipment;
- What levels of protection are required in each of the four PPE Categories;
- How an electrically safe working condition is created;
- When energized work is permitted.

PROGRAM OUTLINE

THE TWO HAZARDS OF ELECTRICTY
- In order to identify and avoid electrical hazards, workers must first understand that there are two main hazards presented by energized electrical equipment.
- The first hazard of electricity is electric shock, which can occur when a worker makes direct contact with or comes too close to energized parts.
- The second hazard of electricity is exposure to an arc flash. Unprotected workers can suffer severe burns when exposed to the sudden, violent release of energy associated with an electric arc, as was this worker who neglected to wear arc-rated clothing.

INTRODUCTION TO APPROACH BOUNDARIES
- To protect workers from the hazards of electricity, the NFPA 70E establishes approach limits at specific distances from exposed energized parts or potential arc sources. These approach limit distances are also referred to as "approach boundaries."
- In a major change to the 2015 NFPA 70E, the number of approach boundaries to protect against electric shock has been reduced from three to two.
- The two approach boundaries for shock protection are the Limited Approach Boundary and the Restricted Approach Boundary.
- The Limited Approach Boundary is the shock protection boundary farthest away from the energized parts and is established to keep unqualified persons a safe distance from exposed live parts.
- Unqualified workers may not cross the Limited Approach Boundary unless briefed on the hazards and continuously escorted by a qualified person.
- The Restricted Approach Boundary is the shock protection boundary closest to the energized parts and may only be crossed by qualified electrical workers following safe electrical work-practices which include wearing appropriate shock protection PPE and using insulated tools.
- The distance from an energized part or conductor to the each of these boundaries increases as the nominal voltage increases.
- There is also an approach boundary established to protect workers from exposure to an arc flash, the Arc Flash Boundary.

APPROACH BOUNDARY DISTANCES FOR SHOCK PROTECTION

- One of the required skills of a qualified electrical worker is determining the approach boundary distances for the equipment on which they intend to work.
- The approach boundary distances for shock protection are dependent on the nominal system voltage in AC systems and on the potential difference in DC systems.
- Once this information is known the approach boundaries may be looked up in table 130.4(D)(a) for alternating current or AC systems and in table 130.4(D)(b) for direct current or DC systems. These table designations are new for the 2015 70E document.
- Referencing the table for a 480-volt AC system yields a Limited Approach Boundary of 1 meter or 3 feet 6 inches and a Restricted Approach Boundary of 30 centimeters or 12 inches.

ARC FLASH BOUNDARY DISTANCE

- Qualified workers must also be able to determine the Arc Flash Boundary for the job task they intend to perform.
- During an arc flash event, a large amount of thermal energy or "heat energy" is released. This thermal energy is measured in units known as calories.
- The amount of thermal energy at a given distance from an arc source is referred to as the incident energy.
- To give you an idea of the amount of heat energy in a calorie, it takes approximately 1.2 calories per square centimeter to cause the onset of a second degree burn on unprotected skin.
- A second degree burn, while painful, is also very curable and typically causes no lasting damage.
- It is for this reason that the Arc Flash Boundary is placed at the distance from an arc source where an unprotected worker will receive the onset of a second degree burn on unprotected skin.
- In other words, the Arc Flash Boundary is placed at the distance from an arc source where the incident energy is 1.2 calories per square centimeter.

DETERMINING THE ARC FLASH BOUNDARY

- One method which can be used to determine the Arc Flash Boundary distance is to perform an incident energy analysis.
- An incident energy analysis is a calculation based on the specific design and condition of the electrical system in question. The incident energy analysis is used to predict the incident energy of a potential arc flash.
- Two of the critical factors used during an incident energy analysis are the maximum amount of short-circuit current available and the speed of any overcurrent protection.
- You may consult 2015 NFPA 70E Annex D for more information on an incident energy analysis.
- To make it easier for electrical workers to determine the Arc Flash Boundary distance, the NFPA has performed an incident energy analysis for common electrical systems and lists the Arc Flash Boundary for these systems in table 130.7(C)(15)(A)(b) for AC systems and 130.7(C)(15)(B) for DC systems.
- It's critical for you to understand that the NFPA developed these tables based on the specific short-circuit current and fault clearing times listed in the table. If your equipment does not match these specifications, you may not use this table to determine the Arc Flash Boundary distance and must use an incident energy analysis.

SELECTING ARC-RATED CLOTHING AND PROTECTIVE EQUIPMENT

- Arc-rated clothing and protective equipment is designed to withstand both the intense heat and force of an arc blast without breaking open or bursting into flames.
- Clothing that is not arc-rated, such as 100 percent cotton or wool, can burst into flames and continue to burn even after the arc is extinguished.
- To provide an appropriate level of protection, arc-rated clothing and protective equipment must be selected to meet or exceed the predicted incident energy level of a potential arc flash at the working distance of the task to be performed.
- The working distance is the distance of a worker's face and chest area from a potential arc source while performing a specific task.
- One method to determine the appropriate arc flash protection is to perform an incident energy analysis and calculate the incident energy at the working distance. Then select arc flash protection rated to meet or exceed this amount of thermal energy.

- To make it easier for electrical workers to determine appropriate arc flash protection, the NFPA has calculated the incident energy level at the working distance of common job tasks performed on common electrical systems. They have also determined the appropriate arc flash protection for those job tasks and have listed it in Table 130.7(C)(15)(A)(b) for AC systems and Table 130.7(C)(15)(B) for DC systems.
- Again, it's critical for you to understand that the NFPA developed these tables based on the specific short-circuit current, fault clearing time and working distance listed in the table. If your planned task does not match these specifications, you may not use this table to determine the appropriate arc flash protection.
- These tables list the required arc flash protection as being in one of four PPE Categories. We will next explain the requirements of each PPE Category Level.

PPE CATEGORIES

- There are many job tasks that do not present an arc flash hazard and do not require arc flash PPE. Table 130.7(C)(15)(A)(a) can be consulted to determine if arc flash PPE is required. When no arc hazards exist, electrical workers may wear long sleeves and long pants made from non-melting natural fiber clothing such as 100 percent cotton or wool.
- PPE Category One requires a worker to wear arc-rated clothing of at least four calories per square centimeter, a voltage rated hard hat and an arc-rated face shield or arc-rated flash suit hood.
- PPE Category Two requires a worker to wear arc-rated clothing of at least eight calories per square centimeter, a voltage rated hardhat and an arc-rated face shield combined with an arc-rated balaclava. If desired, an arc-rated flash suit hood may be used instead of the face shield and balaclava.
- PPE Level Three requires a worker to wear arc-rated clothing of at least 25 calories per square centimeter and an arc-rated flash suit hood.
- PPE Level Four requires a worker to wear arc-rated clothing of at least 40 calories per square centimeter and an arc-rated flash suit hood.
- In addition to the required arc-rated clothing and voltage-rated hardhat, electrical workers must also wear safety glasses, earplugs, proper footwear and arc-rated gloves or voltage-rated gloves with leather protectors.
- Also, keep in mind that electrical workers should not wear any conductive material such as rings, watches, metal frame eye wear or other metal jewelry. These items are not only shock hazards but can cause serious burn injury when super heated by an arc flash.

EQUIPMENT LABELS

- As you have seen, determining the appropriate arc flash protection and establishing the Arc Flash Boundary can be complicated. To make it easier for electrical workers to determine this important information, the 2015 NFPA 70E requires that the owner of electrical equipment install field-labels on equipment.
- These labels must display the nominal system voltage, the Arc Flash Boundary and at least one of the following items: the Arc Flash PPE Category and/ or the Minimum Arc Rating of clothing and PPE.
- If an incident energy calculation was used to determine the appropriate PPE, then the incident energy level and corresponding working distance may be substituted on the label for the Arc Flash PPE Category.
- Having this critical information readily available on the equipment label makes selection of proper arc-rated PPE much easier for electrical workers.

ELECTRICALLY SAFE WORKING CONDITION

- The best way for electrical workers to protect themselves from the shock hazard and arc flash hazard presented by electricity is to create an electrically safe working condition. Creating an electrically safe working condition must always be the first choice for electrical workers.
- The NFPA's definition of an electrically safe working condition is "a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked and tagged in accordance to established standards, tested to ensure the absence of voltage and grounded if determined necessary."
- To create an electrically safe working condition, first determine all possible sources of electrical supply to the equipment.
- Next, disconnect any active loads, then open the disconnecting device for each source of electrical supply.
- Visually verify, if possible, that all blades of disconnecting devices are fully open or that draw-out type circuit breakers are withdrawn to the fully disconnected position.

- Then, apply company approved locks and tags to the open disconnecting devices in accordance with your facility's lockout/tagout procedures.
- Finally, the most important part: testing to verify there is an absence of voltage and grounding when necessary.

VERIFYING AN ABSENCE OF VOLTAGE

- Testing for an absence of voltage must be done using an adequately rated test instrument.
- The test instrument must be verified to be working properly by measuring a known voltage source immediately prior to voltage testing and again immediately afterwards.
- When testing to confirm an absence of voltage, test each phase conductor or circuit part both phase to ground and to phase, for all phases.
- Remember that until you have verified the existence of an electrically safe working condition, the equipment must be considered energized.
- This means that all electrical safe work practices must be followed including establishing approach boundaries, using appropriate insulated tools as well as donning voltage rated shock protection and appropriate arc flash protection.
- Once the existence of an electrically safe working condition is verified, then no electrical hazards exist.
- This means that shock and arc flash protection are no longer necessary and may be removed.
- This also means that other workers who are not qualified electrical workers may enter the area as needed.

ANSWERS TO THE REVIEW QUIZ

1. b
2. a
3. b
4. a
5. c
6. b
7. c

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REVIEW QUIZ

The following questions are provided to determine how well you understand the information presented in this program.

Name_____Date_____

1. Which of the following approach boundaries is not established for shock protection?

a. The limited approach boundary
b. The arc flash boundary
c. The restricted approach boundary

2. The approach boundary distances for shock protection are dependent on the nominal system voltage in AC systems and on the potential difference in DC systems.

a. True
b. False

3. It takes approximately 1.2 calories per square centimeter of thermal energy to cause the onset of a _____ burn on unprotected skin.

a. First-degree
b. Second-degree
c. Third-degree

4. Which of the following is not a critical factor when calculating incident energy?

a. The equipment manufacturer
b. Available short-circuit current
c. Speed of overcurrent protection

5. To provide an appropriate level of protection, arc-rated clothing and protective equipment must be selected to meet or exceed the incident energy level of a potential arc flash at the _____.

a. Outermost boundary
b. Rrestricted approach boundary
c. Working distance

6. Owners of electrical equipment are not required by the NFPA 70E to install field-labels on equipment.

a. True
b. False

7. When should a voltage test instrument be verified to be working properly?

a. Immediately prior to testing
b. Immediately after testing
c. Both immediately prior to testing and immediately after testing